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Information Technology and Organizational Capability - What Chandler Would Think Today?

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ABSTRACT

Organizational capability has been regarded as one of the principle sources of sustainable competitive advantage and the foundation for strategy formulation. Meanwhile, many anecdotal evidences have indicated that information technology (IT) is playing a very important role in building an organization's capabilities. Although there has been a myriad of research on how IT could help in today's fierce business competition, a theoretical foundation regarding the relationship between IT and organizational capability is still missing. This paper attempts to fill this void by borrowing Chandler's points of view toward organizational capability.

Keywords

Organizational Capability, Information Technology, Human Skills, Dynamic Capability

INTRODUCTION

Organizational capability has been regarded as one of the principle sources of sustainable competitive advantage and the foundation for strategy formulation (Grant, 1996). Chandler in his book *Scope and Scale* (Chandler, 1994) attributed the strong development of American and German industry from 1870 to 1938 to the three-pronged investment in manufacturing, distribution, and management they had made during that period of time. The three-pronged investment built up strong organizational capabilities of American and German industrial enterprises to allow them to exceed their peers in Britain who did not make the same three-pronged investment (Chandler, 1992; 1993; 1994). Besides Chandler's historical view of organizational capabilities toward a firm's competitive advantage, some strategic management studies have attempted to research, through case studies, how organizational capabilities were originated and developed over time and how these capabilities led organizations to different destinies (e.g. Raff, 2000; Rosenbloom, 2002; Tripsas and Gavetti, 2000). There is also research discussing about the benefits brought by organizational capabilities (Lorenzoni and Lipparini, 1999) and limitations of the organizational capabilities (Collis, 1994). However, there is a lack of theoretical understanding about how organizational capabilities are created, maintained and improved over time.

Since the beginning of 1990s, organizations have been taking many benefits from the rapid development of information technologies (IT) to create their capabilities in business operations, especially after the commercialization of the Internet. The support from information systems has claimed to be a competitive necessity (Barney, 1996; Clemons and Kimbrought, 1986) or a source of competitive advantages (Byrd, 2001; Kettinger, Grover, Guha and Segars, 1994). Organizations have built up sophisticated information infrastructure and systems to improve their operating efficiency and effectiveness. Many business change initiatives, such as business process reengineering (BPR) and customer relationship management (CRM), etc., rely heavily on IT. Firms' investment in IT has been increasing due to the implementation of these information systems. According to the US federal government, U.S. businesses allocated 47% of all capital investment funds in year 2000, or \$664 billion, to IT, that percentage is twice what it was in 1991 (Strassmann, 2001). Organizations want to use IT to create or improve their capabilities essential to win competitions in today's e-business world. In many cases, such as amazon.com and priceline.com, etc., IT itself is a big part of organization capabilities. Although there are a multitude of evidences regarding the benefits of using IT in organizations and the link between the use of IT and an organization's capabilities is intuitive, there is still a need to theoretically understand why and how IT can contribute to organizational capabilities.

The purpose of this paper is to build a theoretical foundation for examining the impact of IT on organizational capabilities. Chandler's definition outlined two important components of organizational capability: physical facilities and human skills. This paper will discuss the relationship between IT and organizational capabilities from these aspects.

DEFINITIONS OF ORGANIZATIONAL CAPABILITY

Numerous attempts have been made to define the term “organizational capability”. The following is some definitions on organizational capability. Organizational capabilities are

- “a firm’s ability to perform repeatedly a productive task which relates either directly or indirectly to a firm’s capacity for creating values through effecting the transformation of inputs into outputs” (Grant, 1996, p.377)
- “the processes by which a firm is able to reconfigure its resources. These include resources focusing, accumulation, combining, accessing, recovery and defense” (Minshall and Garnsey, 1999, p.318)
- A firm’s capability to deploy its assets, tangible or intangible, to perform a task or activity to improve performance (Maritan, 2001).

Teece and Pisano (1994) introduced the term “dynamic capability” which emphasizes the self-renewing part of the organizational capability. The definitions to this new term are:

- “Dynamic capability is the capacity of an organization to consistently nurture, adapt, and regenerate its knowledge base, and to develop and retain the organizational capabilities that translate that knowledge based into useful actions” (Iansiti and Clark, 1994, p.563).
- Dynamic capability is “the firm’s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments” (Teece, Pisano and Shuen, 1997, p.516).
- “Dynamic capabilities are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die.” (Eisenhardt and Martin, 2000, p.1107)

Although these definitions are somewhat different, all of them are circular in that organizational capability is mostly defined as the capability (or ability) to create capability (or competency). The recursive statement causes vagueness and tautology of the definitions. The terms capability, competency, capacity and resource are often seen being used interchangeably in the literature (e.g. Barney, 1991; Kusunoki and Nonaka, 1998). The concept of capability, along with other streams of research such as transaction cost theory and agency theory, has suffered from a tautological reputation (William, 1999).

In order to properly define organizational capability, the recursive and relational components of the definition must be removed. The term “organizational capabilities” is defined here as *collective activities and resources through which an organization conducts its operations*. Organizational capability is characterized as a collective activity, rather than an individual’s activity because an organization is viewed as a group of people intentionally organized to accomplish a common goal or set of goals. Capabilities exclusively owned by an individual are not a concern in this research because they live or die with the person who owns them and are very volatile. Organizational capabilities can be beneficial ones which improve an organization’s performance; they also can be detrimental ones which lead to declination of an organization.

Chandler (1994) regarded organizational capabilities as “the collective physical facilities and human skills as they were organized within the enterprise” (p.594). He further pointed out that an enterprise must carefully coordinate and integrate these facilities and skills so that it could achieve the economics of scale and scope for national and international competition and continuous growth. However, besides physical facilities and human skills, and as many of the definitions above point out, organizational processes and routines are important components of organizational capabilities too (Eisenhardt and Martin, 2000, Teece, *et al.*, 1997). In sum, organizational capabilities are

- processes or routines of doing things of an organization, such as the process to initiate, investigate, approve an investment proposal, procedures to manufacture a product, procedures to acquire raw materials, etc.
- physical assets or resources, such as cash in the bank, patents owned, brands, number of warehouses around the country, etc.
- human skills, such as skills to assemble a machine, innovation skills, know-how, managerial skills, skills to learn new skills, etc.

IMPACT OF IT ON ORGANIZATIONAL CAPABILITY

IT has become a primary means of managing and reducing the uncertainties surrounding production and administrative processes (Dewett and Jones, 2001), improving customer service and reducing cost (Brynjolfsson, 1994; Brynjolfsson and Hitt, 1996), and improving operation efficiency and effectiveness (Sheng, 2002). In as early as the 1960s, firms deployed the Material Requirements Planning (MRP) systems to manage the inventory and purchasing. MRP was soon upgraded, in the 1970s, to the Manufacturing Requirement Planning (MRP II) systems to include financial and labor resources management in the systems. After several years practice with MRP and MRP II systems, organizations realized that computer systems could link many more departments so the Enterprise Resources Planning (ERP) systems were introduced in the 1980s to integrate all an organization’s transaction processing activities. The ERP systems are still under expansion. Internal suppliers, customers and external suppliers are included in many ERP systems that really have become the Supply Chain Management

(SCM) systems, which promote a firm's operating efficiency to a newer level (Sheng and Mykytyn, 2002; Turban, Wetherbe and McLean, 2000).

IT is also used intensively in Business Process Reengineering (BRP) and Total Quality Management (TQM) projects to increase corporate response speed and operating efficiency. Customer Relationship Management (CRM) also heavily relies on information technology, such as database technology, data mining technique, the Internet, etc., to identify, retain and manage a firm's profitable customers in order to promote the firm's business effectiveness (Sheng, 2002). The Internet is widely used by firms to improve communication and information flow within a firm, to reach and service their customers, and to link to their business partners to smoothen transactions.

Given the popularity of IT in organizations and the demand for stronger organizational capability, I would like to see how IT contributes to the creation, maintenance and renewal of organizational capabilities.

IT and Processes

Organizational process or routine refers to the way things are done in the firm; it has three roles: coordination/integration, learning and reconfiguration (Teece *et al.*, 1997).

Coordination. The main task of the managers of a firm is to coordinate internal and external activities like product development, manufacturing and alliancing to create value through the value chain. Teece *et al.* (1997) pointed out that the capability is embedded in distinct ways of coordinating and combining. A study of 18 room air-conditioning plants conducted by Garvin (1988) reveals that the quality performance was not related to either capital investment or the degree of automation of facilities, rather it was strictly caused by the specific organizational routines/processes.

IT has a great deal of contribution toward coordination, as well as integration explained later. Dell's flexible IT infrastructure enables coordination across company boundaries to achieve new levels of efficiency and productivity (Magretta, 1998). ERP systems, SCM systems and other inter-organizational systems are designed to facilitate the coordination and integration among internal departments and with external partners, suppliers and customers. Within an organization, IT has been used to coordinate activities among employees, units or groups geographically dispersed (Rockart and Short, 1989). The widespread use of communication technology helps solve a major problem for geographically dispersed organizations, i.e. their satellite sites may not operate at a sufficiently high volume to benefit from economies of scale; information is now transferred between remote units as readily and efficiently as can be done within a single physical site (Hammer and Mangurian, 1987).

Beside the coordination between units for different tasks, IT is found to be a great facilitator to coordinate multiple units under similar functions, too; functional teams have greatly benefited from coordinated support from IT (Rockart and Short, 1989). Given the trend of globalization, IT can drastically reduce the cost of coordination and improve the ability to coordinate. The Internet, email, video conferencing technology, groupware software like Lotus Notes, Webinar (Web-based conferencing systems) are excellent exemplar technologies widely used in today's coordination activities.

As for the use of IT in inter-organizational coordination, Argyres (1999) did a case study of the B-2 "stealth" bomber which was designed by four firms almost entirely by using computers. He concluded that the information systems had played a crucial role in enabling the four firms to precisely coordinate their design and development activities to meet the designing engineering requirements imposed by the aircraft's unique mission. The information systems reduced the costs of information processing which, in turn, made the governance of the project more efficient. Also, the technical grammar for communication created by the information systems built up social conventions among the firms, which eliminated the needs for hierarchical authority to promote coordination. The technical grammar also reduced governance costs by reducing the asset-specificity.

Proposition 1. IT improves a firm's organizational capabilities through facilitating intra- and inter-organizational coordination.

Integration. Integration refers to integrate of data, of organizational communications and of business processes across functional, geographically distributed product lines. Today's interconnection capability and shared data accessibility provided by IT make the organizational integration very much possible (Rockart and Short, 1989). IBM Credit Corporation developed a piece of decision support computer software to consolidate the process of credit approval. The approval process for a credit application used to take seven days and go across several departments. Now it is done by one employee at his or her desk in just few hours by using that piece of software (Turban *et al.*, 2000). Information efficiency (Dewett and Jones, 2001) is generated by such IT-enabled integration. BellSouth implemented its intranet-based electronic forms management system to

replace its old paper-based system in 1996. After implementation, employee productivity increased and form generation was reduced from 10 weeks to 24 hours (Johnson, 1996).

Rockart and Short (1989) conducted a fourteen-month research of sixteen major companies. They found IT-enabled integration efforts strikingly improved a company's ability to manage its functional, product, or geographic subunits. Computer networks, computers and databases replace human integrators to manage concurrence of effort between adjacent functions in the value-added chain. Between-function integration increases a firm's capacity to respond quickly and effectively to market forces, to improve the quality of conformance to customer requirements and to reduce costs. IT-enabled between-function integration collapses the multi-stage value-added chain into three major segments: new product development, product delivery to customer and customer relationship management.

Proposition 2. IT improves a firm's organizational capabilities through facilitating intra- and inter-organizational integration.

Learning. Learning is a process by which repetition and experimentation enable tasks to be performed better and quicker and new production opportunities to be identified (Teece *et al.*, 1997). Learning is a key antecedent of innovation (Hurley and Hult, 1998) and IT has been recognized as a facilitator to the process of learning. IT contributes to the learning process at individual level, intraorganizational level and interorganizational level.

At the individual level, the Intranet, database and multimedia technology can be used to establish an integrated learning system, which provides employees with easy and flexible access to information and facilitates problem solving (e.g. Huber, 1990; Malone and Rockart 1991). At the organizational level, organizational memory and learning also heavily rely on IT. IT contributes to the possibility of automated organizational memory systems by either making recorded knowledge retrievable or by making individuals with knowledge accessible (Ackerman, 1996; Anand, Manz and Glick., 1998). At the inter-organizational level, Scott (2000) found, through a study in the disk drive industry, that IT directly and indirectly facilitates inter-organizational learning at lower-level (tracking inventory and quality performance) and higher-level (product design). So in all levels, IT has its contribution to the process of learning, which is a key component of organizational capabilities.

Proposition 3. IT improves a firm's organizational capabilities through facilitating individual learning, intra-organizational learning and inter-organizational learning.

Reconfiguration and Transformation. Based on new developments of the market and technologies, firms need to reconfigure their asset structure and to accomplish internal and external transformation. Two different stages are involved in reconfiguration and transformation: (1) sense the market and technology change, (2) effectuate the necessary adjustment in the firm.

In order to sense the change of market and technology, firms need to deploy certain strategies to collect data, analyze the data and discover the trend of market or technology development. Monitoring the movement of the competitors and benchmarking could be valuable to a firm too. Recent advances in IT, such as intelligent agents for information retrieval and data mining (Francese, 1990; Gerdes, 2003; Gordon and Loeb, 2001; Grupe and Owrang, 1995; Wagner and Turban, 2002), have made these types of tasks much easier and cheaper than before. For example, intelligent computer software agents have been developed to gather and analyze companies' required filings to Securities and Exchange Commission (SEC). SEC's EDGAR database has huge amounts of filings from companies, such agents can search for and record evidence of user-specified objects, for instance, a particular company's financial data (Gerdes, 2003). The results generated by these intelligent agents can be used to conduct competitor analysis or market analysis processes.

Sensing the trend is one thing; to effectuate the necessary process change is another. However, many success stories have indicated that changing from a human-based process to a computerized process might not be very difficult (e.g. Johnson, 1996; Turban *et al.*, 2000). The anecdotal evidence from these cases suggests that many positive rewards from business process engineering relied on computerization.

Proposition 4a. IT improves a firm's organizational capabilities through improving the ability to sense the external changes.

Proposition 4b. IT improves a firm's organizational capabilities through reconfiguring and/or transforming non-computerized processes to computerized processes

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IT and Physical Assets or Resources

Physical assets or resources refer to physical facilities such as factories, offices and laboratories (Chandler, 1994), technology, geographical location, raw materials (Williamson, 1975), financial assets, and brand names, etc. They are distinct from human resources, such as individual knowledge, experiences and know-how, etc., and organizational cultural and structural resources, such as formal reporting systems, controlling and coordinating systems, etc.

IT has its contribution to a firm's assets in many aspects. First, information technologies and information systems themselves are a firm's assets. The computer systems, computer networks, business software application packages, email facilities, the Internet servers, and so on, are all assets owned by a firm to operate its business. Information systems are regarded as a vital component of organizational memory (Stein and Zwass, 1995).

Second, IT helps to manage a firm's assets more efficiently and effectively. Obvious evidence is the wide use of computer accounting systems that have been part of MRP systems since the 1960s. The accounting data in computers, not on paper books, can be manipulated, sorted, analyzed and summarized with ease in a very timely manner. The computer has revolutionized the way enterprises keep their accounting records (Honig, 1999). Through the reports generated from the computerized accounting systems, managers are able to manage their resources more efficiently and effectively by accurately and timely knowing their firm's inventory status, stock level and financial situation. IT provides better access and management to their asset information, which enables organizations to conduct real-time, stimulus-driven planning at all levels, and to bring key issues to the surface and react to the quickly (Rockart and Short, 1989).

Third, IT helps to enhance a firm's assets, such as relationship with customers and suppliers. Relationship is a kind of asset (Srivastava, Shervani and Fahey, 1998). By maintaining a close relationship with its customers, Dell learns its customers' preferences from each interaction. For large customers, Dell sends an account manager to acquire specific knowledge about the software and system configurations of its customers. When the customers buy computers from Dell, Dell installs and configures the software for them on the assembly line. Dell customers are thrilled by this capability because it saves customers' time and money to install and configure software on these computers by themselves (Hopkins *et al.*, 1999). The relationship between Dell and its customers is tightened through meeting the customers' needs. The use of IT in managing customer relationships is becoming popular nowadays. Customer Relationship Management (CRM) system is an IT-based system to manage a firm's customer base to improve business effectiveness (Sheng, 2002). CRM can integrate all touch points, such as phone, fax, email, online chat, etc., to the customers. All customer services representatives at different touch points can have an identical view to all customers' historical data, behavioral data and preference data. The Internet, data mining technology, and call center technologies have dramatically improved the ability of corporations to understand and interact with their customers. The Internet is a great channel for data collection, dissemination and communication. Data mining technology is to discover patterns of consumers' behaviors and preferences. Moreover, nowadays it is not enough to know only customers' needs; customer profitability is a new key metric in companies (Hopkins *et al.*, 1999). CRM allows companies to gather and analyze customer data, identify valuable customers over time, and increase customer loyalty by providing customized products and services; companies can keep profitable customers closer, transform unprofitable customers or products to profitable ones, or discard non-profitable customers through IT-based CRM systems (Cooper, Watson, Wixom and Goodhue, 2000; Rigby, Reichheld and Schefter, 2002; Sheng, 2002).

Fourth, IT helps to create a firm's assets, such as organizational memory and organizational knowledgebase. It is almost impossible to seriously talk about organizational memory and organizational knowledgebase without relating them to IT. Advances in IT, such as hard disks with huge capacity, the Internet, and information searching software/tools, have greatly helped create and maintain organizational memory and have facilitated the ability to capture and integrate explicit knowledge by making it easy to codify, communicate, assimilate, store and retrieve (Anand *et al.*, 1998; Dewett and Jones, 2001). Besides this, information systems can turn organizational memory from media-rich systems into available organizational knowledge (Croasdell, 2001). Stein and Zwass (1995) suggest that increasing use of information systems can leave an extensive record of processes ("through what sequence of events?"), rationale ("why?"), context ("under what circumstances?"), and outcome ("how well did it work?"), all of which are or can be organizational knowledge.

Proposition 5. IT improves a firm's organizational capabilities through becoming, managing, enhancing and creating organizational physical assets.

IT and Human Skills

Skill is defined as "the specific capacity to physically manipulated objects"; skill is different from ability which represents "a broad and stable characteristic responsible for a person's maximum --- as opposed to typical --- performance on mental and physical tasks" (Kreitner and Kinicki, 1998, p.138). Skill itself is a very broad concept. Chandler (1994) mainly focuses on

technical skills and managerial skills. Superior technical skills in innovations and manufacturing allowed American and German enterprises to become first movers to introduce new products and adopt new manufacturing processes. Superior managerial skills of the managers of American and German enterprises allowed them build up a highly specialized managerial hierarchy to manage product diversification and geographical diversification to expand the enterprises. There are many other skills, such as organizational skills (Wade and Parent, 2001), human skills and conceptual skills (Katz, 1974). Because information technology is mainly regarded as a tool to carry out a task or to solve a problem, this paper focuses on how IT impacts human skills to fulfill tasks or solve problems.

There is a wealth of literatures reporting the use of IT that can positively impact the incidence and quality of problem solving. For example, according to Simon (1997), computer serves as memory, processor and a channel to access external information in today's decision making process. Using computers to model complex situations and to infer the consequences of alternative decisions is common today. Because of this, the corporate decision-making processes are becoming significantly more sophisticated and rational than they were in past eras. Managers have more help than before to identify, evaluate and solve problems. Edmondson and Moingeon (1998) reports that increasing online interdependencies makes critical information more accessible and transparent to employees, which increases the incidence of problem-solving. Although the impact of IT on the incidence and quality of problem solving has been researched, still there is a lack of research to study why and how IT can improve or impede human skills, which, in turn, lead to better or worse problem solving performance. An obvious benefit of using IT in problem solving resides in the ease of information collection and processing provided by IT, as Simon (1997) pointed out. However, more information and higher processing ability of computers do not necessarily lead to better problem solving performance. Paul and Mukhopadhyay (2001) found that IT enhanced student-student and student-faculty communication and collaboration, and improved students' access to information. However, use of IT did not improve students' analytical and problem solving skills, so the exact role of IT in influencing a person's problem-solving skills needs to be explored. In order to conduct such research, one needs to identify the determinants of human problem solving skills and investigate how IT affects each of them.

Another researchable question is, on the one hand, IT can help solve certain problems; on the other hand, IT can increase a person's IT dependence so that it actually lowers the person's own problem solving skills due to lack of practice and training. Three propositions can be presented as follows:

Proposition 6a. IT improves a firm's organizational capabilities through improving employees' problem-solving skills.

Proposition 6b. IT impedes a firm's organizational capabilities through lowering employees' problem solving skills by fostering their tendency to rely on IT to solve problems.

Figure 1 is the graphical representation of the theoretical model described by the hypotheses above.

CONCLUSION AND DISCUSSION

Chandler (1994) emphasized how important organizational capabilities are to a firm. The three-pronged investment made by American and German enterprises built up their tremendous organizational capabilities. Investment in manufacturing allowed the American and German enterprises to reduce cost and diversify products; investment in distribution allowed them to reach foreign markets; and investment in management allowed them to have enough skilled salaried managers so as to expand their operations, both product-wise and location-wise. There are a plethora of literature discussing IT's positive contributions toward building organization capabilities and providing competitive advantages, but there is a lack of fundamental understanding about why and how IT can achieve this. This paper attempts to explore the issue by looking at why and how IT can influence each building component of the organizational capabilities.

IT is found to positively contribute to most of the components of organizational capabilities. However, IT will be a problem when a firm becomes highly computerized because it will be a very high cost associated to change a computerized process. The research in how IT can impact on human's problem solving skills is not intensive enough to make a conclusion on it. Mixed results have been found. So this paper does not make an exclusive conclusion on the issue. Further research is needed to explore possible answers. Empirical study on the propositions presented in this paper is very much needed too.

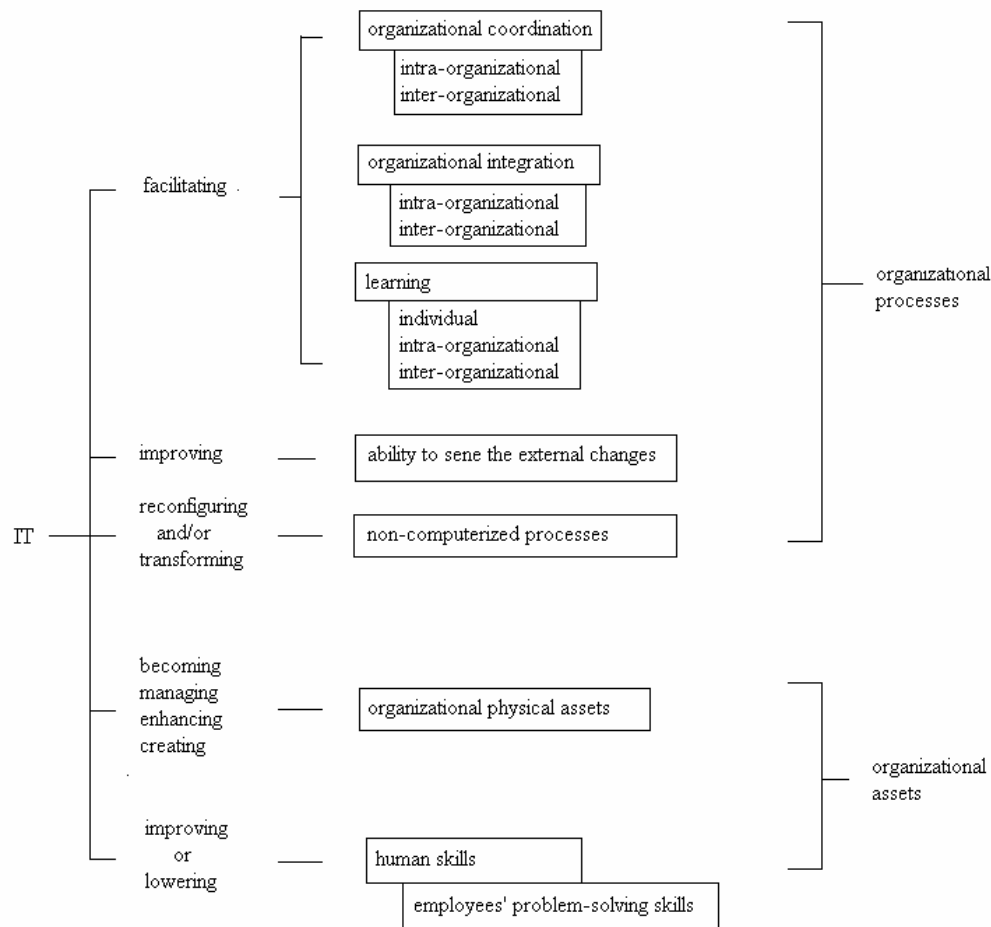


Figure 1 Theoretical Model

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